INDIANA DEPARTMENT OF TRANSPORTATION
DIVISION OF MATERIALS AND TESTS

CLASS AP COARSE AGGREGATE
ITM No. 210-14

1.0 SCOPE

1.1 This method sets forth the control procedures used for classification of an aggregate as Class AP.

1.2 The coarse aggregate is incorporated into the casting of concrete beams, and the beams are cured and tested in a freeze and thaw cycling procedure. The length of the concrete beams is measured before and after the test to determine the average maximum change in length.

1.3 This ITM may involve hazardous materials, operations, and equipment and may not address all of the safety problems associated with the use of the test method. The user of the ITM is responsible for establishing appropriate safety and health practices and determining the applicability of regulatory limitations prior to use.

2.0 GENERAL REQUIREMENTS.

2.1 No testing of the aggregate will be made until the material is rated Class A aggregate; however, the material may be tested for class A and AP concurrently if so directed by the Department. Blending or combining of a ledge that does not meet quality or deleterious requirements will be permitted only by the approval of the Department.

2.2 The coarse aggregate Producer shall provide a written description of the production control in the Source Quality Control Plan in accordance with ITM 211. This plan shall specify the ledges to be incorporated into the production for crushed stone, the relative production zone within the pit for gravel, general handling and crushing procedures used in the production, the final production gradation obtained, and any other pertinent information relative to the coarse aggregate production, such as stockpile signage. Any unauthorized change in the approved Quality Control Plan will be cause for the suspension of shipment of this material.

2.3 Tests will be conducted by the Division of Materials and Tests or a Department approved AASHTO Accredited Laboratory until Department tests are available. Department tests results will control the re-sampling schedule.

3.0 REFERENCES.

3.1 AASHTO Standards.

M 85 Portland Cement
M 92 Wire Cloth and Sieves for Testing Purposes
M 154 Air-Entraining Admixtures for Concrete
M 210 Apparatus for Use in Measurement of Length Change of Hardened Cement Past, Mortar, and Concrete
M 231 Weighing Devices Used in the Testing of Materials
T 27 Sieve Analysis of Fine and Coarse Aggregate
T 119 Slump of Hydraulic Cement Concrete
T 121 Mass Per Cubic Meter (Cubic Foot), Yield, and Air Content (Gravimetric of Concrete)
T 152 Air Content of Freshly Mixed Concrete by the Pressure Method
T 161 Resistance of Concrete to Rapid Freezing and Thawing
T 196 Air Content of Freshly Mixed Concrete by the Volumetric Method

3.2 ASTM Standards.

C192 Making and Curing Concrete Test Specimens in the Laboratory
C666 Resistance of Concrete to Rapid Freezing and Thawing

3.3 ITM Standards.

203 Control Procedures for Classification of Aggregates
207 Sampling Stockpiled Aggregates
211 Certified Aggregate Producer Program

4.0 TERMINOLOGY. Definitions for terms and abbreviations shall be in accordance with the Department's Standard Specifications, Section 101.

5.0 SIGNIFICANCE AND USE. This ITM shall be used to classify aggregates as Class AP for use as designated in the Standard Specifications.

6.0 APPARATUS.

6.1 Balance, G2, in accordance with AASHTO M 231

6.2 Beam molds, in accordance with AASHTO T 126, except for the dimensional requirements

6.3 Freezing and Thawing Apparatus, in accordance with AASHTO T 161

6.4 Length Comparator, in accordance with AASHTO M 210

6.5 Mechanical Sieve Shaker, in accordance with AASHTO T 27

6.6 Oven, appropriate size capable of maintaining a uniform temperature of 230 ± 9°F

6.7 Sieves, in accordance with AASHTO M 92

6.8 Miscellaneous equipment, such as tamping rods, scoops, trowels, straightedge, mixing bowl, sieve brush, etc.

7.0 SAMPLING. An approximate 300 lb coarse aggregate sample of the material to be tested will be obtained in accordance with ITM 207.

8.0 PREPARATION OF TEST SPECIMEN.

8.1 Coarse Aggregate. The sample shall be separated into the required sieve sizes in accordance with AASHTO T 27. The quantity from each sieve size shall be recombined to obtain the following gradation:

Sieve Size	Percent Passing
1 in.	100
3/4 in.	95
1/2 in.	55
3/8 in.	35
No. 4	0

The sample shall be submerged in water for at least 24 h prior to mixing for beam casting and shall be SSD at the time of mixing.

8.2 Fine Aggregate. The fine aggregate sample will be No. 23 natural sand from Source No. 2310. The sample will be separated into the required sieve sizes in accordance with AASHTO T 27. The quantity from each sieve size will be recombined to obtain the following gradation:

Sieve Size	Percent Passing
No. 4	100
No. 8	87
No. 16	67
No. 30	42
No. 50	9
No. 100	0

8.3 Cement. The cement will be Type I cement in accordance with AASHTO M 85 from Source No. 0002.

8.4 Air Entraining Admixtures. The air entraining admixture shall be Catexol VR in accordance with AASHTO M 154 from Source No. 8273.

8.5 Mix Design Parameters. The concrete shall have the following properties:

Portland Cement Content	564 lb/yd^3
Water/Cement Ratio (Weight Basis)	0.43
Air Content	6.5 ± 1.5%
Absolute Volume of Coarse Aggregate (Saturated Surface Dry)	0.40

8.5.1 The air content shall be determined in accordance with AASHTO T 152 or AASHTO T 196.

8.5.2 The unit weight shall be determined in accordance with AASHTO T 121.

8.5.3 The slump shall be determined in accordance with AASHTO T 119.

8.6 Casting of Test Beams. The beams shall be cast in accordance with ASTM C192 and the beam dimensions shall be 3 in. x 4 in. x 15 in. (depth x width x length). Three or five beams shall be cast depending on the source of aggregates as determined by the Department. Gage studs shall be cast into both ends of the beams. The gage studs shall be stainless steel hex bolts 1/4 in. - 20 UNC 1 in., with the threaded end finished in accordance with AASHTO M 210.

8.7 Curing of Cast Beams. As soon as the concrete surface is capable of supporting a curing material, the beams will be covered with two layers of wet burlap (or similar material) and one layer of at least 4 mil thick plastic sheeting. After 24 h, the beams will be de-molded and placed in submerged curing conditions in accordance with ASTM C192. At an age of 14 days the freeze-and-thaw exposure will begin.

9.0 PROCEDURE.

9.1 Immediately after the curing period, bring the beams to a temperature of 40 ± 3°F in water.

9.2 Measure the length of the beams from stud tip to stud tip using a length comparator in accordance with AASHTO M 210.

9.3 Apply freeze-and-thaw cycling in accordance with ASTM C666, Procedure B. The freeze-and-thaw unit will be adjusted to achieve 8 cycles per day (approximately 3 h per cycle).

9.4 Measure the length of the beams at least every 50 cycles throughout the testing at 40 ± 3°F. Check the gage studs to assure that no movement of the studs has occurred.

9.5 Continue the test until at least two beams break or until at least 350 cycles are achieved. When five beams have been cast, continue the test until at least three beams break or until at least 350 cycles are achieved.

10.0 CALCULATIONS.

10.1 Calculate the length change in percent as follows:

$$Lc = \frac{l_2 - l_1}{Lg} \times 100$$

where:

L_C = length change of the test beam after C cycles of freezing and thawing, %
l_1 = length comparator reading of beam at 0 cycles, in.
l_2 = length compactor reading of beam at C cycles, in.
L_G = effective gage length between the innermost ends of the gage studs

11.0 REPORT.

11.1 Test Report Data will include the following items:

11.1.1 Concrete batch weights

11.1.2 Coarse aggregate source identification

11.1.3 Type of material

11.1.4 Gradation of production material

11.1.5 Ledges of aggregate, if applicable

11.1.6 Date sampled

11.1.7 Individual(s) obtaining sample

11.1.8 Number of beams cast

11.1.9 Plastic concrete parameters (air content, unit weight, and slump)

11.1.10 Duration of freeze-and-thaw cycle used

11.1.11 Date of test completion

11.1.12 Initial length of each beam, length of each beam after C cycles, length change of each beam, and average length change for the beams.

Length change values for each beam and the average of all beams will be reported to the nearest 0.001 percent.

11.1.13 Plot of percent length change versus number of cycles for each specimen

11.1.14 Brief description of any specimen which failed during the test including any distress observed from the beams during the testing

11.1.15 Retest date

12.0 AGGREGATE ACCEPTANCE OR REJECTION CRITERIA.

12.1 Aggregate Acceptance Criteria.

12.1.1 Department Acceptance Criteria. The average of all of the beams tested shall be less than .060 percent expansion. When three beams are cast, two of the three beams shall be less than .060 percent expansion. When five beams are cast, three of the five beams shall be less than .060 percent expansion. Broken beams shall be excluded to a maximum of one broken beam per test beam set when three beams are cast and a maximum of two broken beams per test beam set when five beams are cast.

12.1.2 Approved Laboratory Test Results. Acceptance of test results from an approved laboratory will be considered if the test results are less than two years old at the time of submission.

12.2 Retesting of Class AP Aggregate.

12.2.1 AP aggregate sources with an average beam expansion of 0.010 percent or less will be sampled and tested at least every three to five years.

12.2.2 AP aggregate sources with an average beam expansion greater than 0.010 percent but less than 0.045 percent will be sampled and tested at least every two years.

12.2.3 AP Aggregate sources with an average beam expansion of 0.045 percent but less than 0.060 percent will be sampled and tested at least annually.

12.2.4 The Department may approve the retesting of aggregates for AP use by an approved laboratory if prior written request is made and approval is given. In all cases, the Department will obtain the aggregate samples and properly identify them.

12.3 Re-Sampling of Rejected Aggregate. After one year or when enhancing process changes have been made, additional sampling and testing may be considered. Requests for additional sampling and testing shall be submitted in writing to the State Materials Engineer, Division of Materials and Tests with a copy to the appropriate District Testing Engineer. If less than one year has elapsed, an explanation of the enhancing process changes shall be included.